In the next step, the grouping proposed for clustering fuzzy design structure matrix is presented. Finally, using the matrix of hierarchical relationships, priorities and the importance of clusters are determined.
Analytical Network Process (ANP) is used for fuzzy evaluation method. In the literature related to the design structure matrix in this case, the Analytical Hierarchy Process (AHP) has been used. considering the AHP hierarchy, some of interactions between elements have been ignored. Therefore, this shortage has been resolved by the ANP and the interactions between the elements have been considered and evaluated with higher accuracy.

The proposed approach has been implemented on a servomechanism with two degrees of freedom. The system has 15 elements determined by the designers. By implementing this approach, two independent elements and three clusters have been determined.

Key Words: Elements, product-based design structure matrix, clustering, fuzzy set theory, analytical network process (ANP).

MODELLING & SOLVING THE VEHICLE ROUTING PROBLEM IN DISTRIBUTION OF A SUPPLY CHAIN CONSIDERING RESTRICTION ON THE MOVEMENT OF THE VEHICLES

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Abstract

Since precise assignment of vehicles to the routs in supply chain network has a great effect on the important results such as cost reduction, on time delivery of the products or services, and customer satisfaction indexes (CSI), the Vehicle Routing Problem (VRP) is one of the most important problems in the supply chain management. For the complexity of this problem in real world, researchers usually ignore some real conditions and restriction in modelling and solving this problem. In this paper, the Vehicle Routing Problem (VRP) considering real conditions, such as vehicle capacity and restriction for vehicles with their movement in some routes, is studied. At first, the literature review and past studies are presented. Then, the considered problem will be illustrated completely and its parameters and variables will be defined. After that, the mathematical model of the problem is presented considering restriction for movement of the vehicles. This mathematical model will be coded in GAMS software; because this problem is known as an NP-Hard problem, the mathematical model of the problem is solved just for the small-sized problems. A new model is also presented for the medium- and large-sized problems based on ant colony (AC). The parameters of the ant colony are adjusted well in order to increase the efficiency of the algorithm. Finally, some diversity test problems are designed considering the important and effective parameters. These test problems are solved in order to evaluate the efficiency of the proposed algorithm, and the result shows that the proposed algorithm has a good performance in solving the test problems. Performance of the proposed algorithm is also compared with two power algorithms tabou search (TA) and genetic algorithm (GA) in solving the test problems. Results show that the proposed algorithm has better performance both in optimality and running time comparison of two other algorithms.

Key Words: Vehicle routhing problem, supply chain system, distribution, ant colony algorithm.

REVIEWING AN INTEGRATED APPROACH OF PRODUCT DESIGN STRUCTURE MATRIX (DSM) AND FUZZY SET THEORY (FST) TO CLUSTERING COMPLEX PRODUCT

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Abstract

The purpose of this paper is to present an integrated approach to the design of structure matrix and fuzzy set theory; and also to provide a method for clustering the system elements. In this approach, know as the “fuzzy design structure matrix”, integer numbers are replaced by fuzzy numbers. In fact, one of the problems of designing structure matrix analysis using numbers integer, considering the lack of distinction between the dependence of the interactions of system elements is that such problems will be solved with this approach. On the other hand, the fuzzy design structure matrix of interactions between elements, cost and less time is spent on systems analysis.

According to the literature, there are different methods for clustering system elements. By studying the clustering methods as well as mathematical approaches derived from graph theory, a proposed approach for clustering fuzzy design structure matrix was presented. The proposed approach has five major steps. Each step also includes several subsets. In the first step, the elements are identified with inputs from designers and system boundaries are determined. In the second step, the fuzzy numbers are used in fuzzy evaluation method. In the third step, the basic fuzzy design structure matrix is formed.

ognized based on customer demands and move directly from the receiving dock to shipping dock, without being held as inventory in the warehouse. Cross docking systems can decrease the storage and products retrieval costs in comparison with traditional warehouses by synchronizing the flows of inbound and outbound trucks. Generally, cross docking is a good strategy for companies that distribute large volume of products and/or serve a large number of stores.

Cross docking facilities include four main functions of warehousing. These four major functions are receiving, storage, order picking, and shipping. Among these four functions, storage and order picking are typically the most costly. Storage function is costly because of inventory holding costs. On the other hand, order picking is expensive because it needs labour work. Cross docking minimizes the storage and order picking functions of a warehouse while it still allows receiving and shipping the product items.

This paper proposes a novel meta-heuristic based method for scheduling vehicles in cross docking problems with considering temporary storage. In other words, products can be stored in a temporary storage and wait for loading in an outbound truck. The objective of the proposed method of this paper is to minimize makespan. Makespan in this study is defined as the total operating time of the cross docking operation. The makespan covers the interval between the moment of unloading the first product from an inbound truck into receiving dock and the moment of loading the last product into shipping truck. In order to evaluate the performance of the proposed method, different problems are provided and analyzed. Moreover, the proposed method of this paper is compared to a well-known method of literature. The computation results reveal that the proposed method of this paper outperforms the compared method.

Key Words: Supply chain management; cross docking; meta-heuristic algorithms; scheduling.

INTEGRATED LOCATING HELICOPTER STATIONS AND HELIPADS FOR THE WOUNDED TRANSFER UNDER DEMAND LOCATION UNCERTAINTY

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Abstract

Health Emergency Medical Service (HEMS) plays an important role in reducing injuries by providing advanced medical care in the shortest time and reducing the transfer time to advanced treatment centers. Injury and harm make sudden changes in the performance of body and organs. Most of these injuries can become serious without intervention, but they are resolvable with quick and in-time measures. Locating helicopter stations makes it possible and easier to transfer emergency patients to medical centers in regions without ground relief coverage. Emergency helicopter can pass directly between two points, cover vaster area, and have higher speed than ground ambulances; therefore, they can give better service to emergency injuries or injuries with limit access to hospitals. Some points are geographically mountainous or have high population density that disturb the helicopter landing process. Therefore, it seems critical to install helipads for successful implement of HEMS. Generally, there are three following assumed transfer modes: (1) Transferring patients directly to the hospital by ambulance from demand areas, (2) At first, moving patients to the helicopter station by an ambulance, then transferring them to a hospital by a helicopter deployed at the station, (3) Transferring patients to helipad by ambulance, then transferring them to the hospital by the helicopter. Subject to the uncertainty of incident points in the real world, in this paper, we assume that a demand occurs in a square demand area, and its length and width follows uniform distribution. The necessity of assuming demands in an area is to decrease errors, produced when the travelled distance between cities or facilities in the area is assumed as the distance between the areas's center points. In this paper, an integer nonlinear programming model has been presented for integrated locating of helicopter stations and helipads considering uncertainty in demand points. The purpose of this model is minimizing the transfer time from demand points to hospital considering different modes. To evaluate the model, a simple numerical example has been presented, and its results have proved the HEMS system more advantageous in comparison with the traditional system. In addition, based on a case study, we performed a study in Lorestan province, to establish optimum places for helipads and helicopter stations and allocate the type of each facility to demand regions.

Key Words: Helicopter emergency medical service, emergency medical service, transfer point location problem, uncertainty.

software in small-sized problems. In large-scale problems, besides the common criteria such as the best solution, average solution, and relative percent deviation, the performance is compared with a parameter-tuned genetic algorithm using a chess rating system. The results of numerical examples demonstrate the acceptable performance of the proposed solution approach.

Key Words: Closed loop supply chain, recycling, differential evolution, response surface methodology, chess rating.

DEVELOPING MIXED EXPONENTIALLY WEIGHTED MOVING AVERAGE-CUMULATIVE SUM & CUMULATIVE SUM-EXPONENTIALLY WEIGHTED MOVING AVERAGE CONTROL CHARTS FOR MONITORING PROCESS MEAN BASED ON RANKED SET SAMPLING

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Abstract

Control charts are powerful tools of statistical process control (SPC) used for monitoring processes. Control charts are not only used to detect changes in process, but also enable the quality engineers to prepare the system for an appropriate response before production of the faulty products. The main objective of most researches on control charts is developing a favorable and cost-effective design as well as most appropriate sampling methods. In most of the researches that have been done in this field, the control charts are designed based on simple random sampling (SRS). However, there are many charts in the literature of statistical process control that are not based on SRS and use alternative methods such as ranked set sampling (RSS) or generalized methods. The RSS method is an alternative to SRS when taking actual measurement of the quality characteristic is costly or production of the faulty products is expensive. In this paper, in order to improve the performance of mixed EWMA-CUSUM (MEC) and mixed CUSUM-EWMA (MCE) control charts in estimating the population mean, ranked set sampling method rather than common simple random sampling method is used to design these mixed control charts. The performances of the proposed MEC-RSS and MCE-RSS control charts are evaluated through simulation studies using the average run length (ARL) criterion. Moreover, the performances of the proposed control charts are compared with those of CUSUM-SRS, CUSUM-RSS, EWMA-SRS, EWMA-RSS, MEC-SRS, and MCE-SRS control charts. The results revealed that RSS method improves control charts performance compared to SRS method because it provides an efficient estimation of the mean and variance of the population. In addition, using the ranked set sampling scheme makes the proposed mixed control charts more sensitive to detecting the small and moderate shifts in the process mean than the other corresponding classical control charts. Moreover, based on the same sampling methods, the performances of mixed control charts are better than those of the single CUSUM and EWMA control charts.

Key Words: Statistical process control (SPC), exponentially weighted moving average (EWMA) control chart, the cumulative sum (CUSUM) control chart, ranked set sampling (RSS) method.

A NOVEL META-HEURISTIC BASED METHOD FOR SCHEDULING VEHICLES IN CROSS DOCKING PROBLEMS

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Abstract

Cross docking is a product-handling and distribution concept in which product items are sorted out and rec-

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Abstract

In traditional Supply chain management, the focus of the integration of supply chain network is usually on a single objective, i.e., minimum cost or maximum profit. However, the modelling of a supply chain requires more than a single objective such as lead-time minimization, service level maximization, and so on. Sometimes, these objectives may cause conflicts such as increasing the service level which usually leads to a growth in costs. Therefore, the aim must be to find trade-off solutions to satisfy the conflicting objectives. In multi-objective optimization problems, there is no single optimum solution, but there is a solution set which creates Pareto optimal solutions. Pareto optimal solutions are a set of trade-offs between different objectives and are non-dominated solutions, i.e., there is no other solution which would improve an objective without causing worsening of at least one of the other objectives .This paper introduces a bi-objective optimization model of a multi-product multi-period three-echelon supply chain network consisting of manufacturing plants, distribution centers, and customer nodes. the two objectives are minimization of the total cost while maximizing the average safe inventory levels of manufacturing plans and distribution centers. The goal is to determine the quantities of the products produced by the following: the manufactured plants in different periods, number and locations of the warehouses, quantities of products transported between the supply chain entities, inventory of products in warehouses and plants, short safe inventory of product in warehouses and plants, and shortage quantity of the customer nodes. The problem is first formulated into the framework of a constrained bi-objective mixed integer nonlinear programming model. Then, to solve the problem, two multi-objective decision-making (MODM) methods are investigated. Then, the performances of these methods are compared in terms of both the solution quality and CPU time required in an attempt to select the best one. For this purpose, Statistical hypothesis test and TOPSIS methods are used. Finally, using some parameters, a sensitivity analysis has been carried out to test the sensitivit of the proposed model.

Key Words: Supply chain management, multi-objective optimization, statistical hypothesis test, MADM.

A PRIORITY-BASED DIFFERENTIAL EVOLUTION ALGORITHM FOR REDESIGNING A CLOSED-LOOP SUPPLY CHAIN USING ROBUST FUZZY OPTIMIZATION

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Abstract

During recent years, the reduction of the natural resources, besides the importance of the environment issues, has led governments to pay attention to closed-loop supply chain concepts, which encompass recycling as well as preparation of products and avoid the sub-optimality caused by a separate design of forward and reverse logistics. Governments may define some policies, such as financial intensity, for those companies that perform recycling activities. Companies may move toward redesigning theirs supply chain structure by considering recycling and collection centers to get financial advantages.

In this paper, considering a reward/penalty mechanism, a nonlinear programming model with the aim of minimizing the total cost is proposed for making decisions about recycling rate, locations of recycling sites, and redesigning of the transportation network in a closed-loop supply chain. Fuzzy concept is applied to cope with uncertainty of parameters in real situation. Costs, demand, and capacity are presumed as the sources of uncertainty. Robust possibilistic programming is applied to improve robustness of the decisions in contrast with the uncertainty. Due to the complexity of the model and loss of the efficiency of the exact solvers, especially in large-sized problems, a differential evolution (DE) algorithm as a population-based meta-heuristic is developed to solve the model. Since the performance of evolutionary algorithms can be strongly affected by the problem representation, a heuristic procedure based on priority-based encoding is designed to show a solution whose efficiency is higher than the standard form of priority-based encoding. Parameters of the proposed algorithm are adjusted using response surface methodology. The performance of the proposed DE is checked by GAMS

allowable to open some services. In addition, it is possible to service each demand point by several hospitals and getting service from one hospital by several demand points.
A bi-objective mixed integer linear mathematical programming model is presented. This bi-objective model minimizes the total network designing costs while maximizing equity throughout hospital network. Therefore, the equity is defined as the ratio of quality of providing services to distances from demand points to facilities, because the quality of services and access to care are two vital factors that directly affect the entire patient's satisfaction.
We solve the model by a new version of ε-constraint method (i.e., the augmented ε-constraint). Also, real data from healthcare facility network in the Isfahan province of Iran is applied for validation purposes. The sensitivity analysis is done on the main parameters. Results show that the proposed model can be used to decide on designing and capacity planning of healthcare facilities.

Key Words: Location- allocation, healthcare facility, capacity planning, augmented ε-constraint.

CONDITION MONITORING AND RELIABILITY MAINTENANCE OPTIMIZATION OF 1-SHOT SYSTEMS

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Abstract

In this paper, we have developed a novel approach to reliability maintenance of one-shot systems such as military missiles and rockets. The reliability estimation and maintenance of these stretegic products are crucial and challenging, and the area has not yet been fully developed. In our new approach, we take a sample of the finished products and deconstruct it into their parts. These parts are then further divided, according to their intrinsic nature ,into the class of testable parts with destruction, the class of testable parts without destruction and the class of non-testable parts. We have considered that the first two classes of parts have increasing rate of failure, while the third class of parts has a constant rate of failure. We apply destructive and non-destructive tests according to the state-of-the-art testing technology and the cost associated with it. We then have integrated concepts and techniques from maintenance planning, condition monitoring, Genetic Algorithm, Bayesian method, and variance propagation to optimize the relibility of standing products. From maintenace planning, we find the optimal inspection period. From condition monitoring, we learn how to perform non-destructive tests. By using genetic algorithm, we estimate nea-optimal number of samples for each part. Also, Bayesian method is used to estimate the system reliability when the sample size is small which is the case for one-shot systems. In fact, through Baysian process, the reliability information obtained by the new tests is integrated into the prior estimations in order to minimize the sample size. Finally, by variance propogation technique, we communicate the mean and variance data estimated at the lower part level up to higher level of sub systems and the total system. This new approach enables us to estimate the reliability of the total system using the reliability information of the constituent parts. Our aim is to maintain the reliability of stand-pile products while the life cycle cost is also minimized. We have tested the proposed approach on the sounding rocket separation system of the explorer missile system built in Iran.

Key Words: Reliability, one shot systems, maintenance, condition monitoring, non-destructive tests, exponential components, bayesian method, optimization.

MODELING AND SOLVING A THREE-ECHELON SUPPLY CHAIN PROBLEM USING STATISTICAL HYPOTHESIS TEST AND TOPSIS AND SAW METHODS

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POLICIES AND COOPERATIVE ADVERTISING CONSIDERING THE COSTS OF INVENTORY IN A TWO-LEVEL SUPPLY CHAIN

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Abstract

Today, organizations are aware of the importance of appropriate pricing and cooperative advertising in profitability and survival of the organization. To coordinate decisions and activities of the organization, it is expected that many benefits will be available to members. This article discusses the coordination of pricing policies and determines the amount of cooperative advertising considering the costs of inventory in a two level supply chain, including a manufacturer and a retailer with demand depending on pricing and cooperative advertising in which the manufacturer offers its product only in the retail channel and the retailer does the purchase only from the manufacturer. The purpose of this is, first, to determine the wholesale price, the amount of national advertising and, the participation rate in local advertising by the manufacturer. Second, its propose is to determine the retail price and local advertising by the retailer. In this research, the ordering quantity of the retailer is the problem input. The problem has been solved by the two non-cooperative games of Nash and Stackelberg-retailer and a cooperative game in which the members work together to maximize the profit of the entire chain with several numerical examples; the acquired results for each game are compared. These results indicate that the profit of the entire chain in cooperative game is more than the two other games, and also the profit of the manufacturer and retailer in the Stackelberg-retailer game is more that in the Nash game. The retail price is the lowest in the Stackelberg-retailer game. The results show that the amount of national and local advertising is highest in the cooperative game and the lowest in the Stackelberg-retailer game. Finally, the effect of changing the parameters of the problem have been investigated on the wholesale price and retailer price in which the effect of change in the cost of production on the wholesale price is higher than the retail price, and the effect of base demand change based on the retail price is higher than the wholesale price.

Key Words: Supply chain, pricing, inventory, cooperative advertising, game theory.

A BI-OBJECTIVE LOCATION-ALLOCATION MODEL AND CAPACITY PLANNING IN HEALTHCARE FACILITY NETWORK DESIGN

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Abstract

Healthcare constitutes one of the largest shares in economy. Ageing population, shortage of resources, and increasing costs of medical services cause many changes in healthcare systems. Healthcare facilities are one of the most important components of these systems. Due to these increasing changes, the facility network should be designed to use the resources optimally and serve the needs of population. In other words, managers try to design the network in the best way in order to significantly reduce the costs and improve the patient satisfaction.
In this paper, a multi-service hospital network is presented for designing and capacity planning of healthcare facilities problem. In this model, some strategies are considered such as: 1) establishing new facilities on favorable sites, 2) opening new services in facilities, 3) determining the optimal capacity for existing and new facilities, and 4) allocating of demand points to facilities. Facilities provide various services that are different in type, size, and quality. In some of them, it may not be

efficiency and performance in all levels of the chain and with supply chain managment approach, there will be a coordination from the beginning of a project (contractor selection) to the end of project (handover of project). Contractor selection is the foremost part of construction projects which in this multi-criteria decision-making, the best contractor is determined by expert judgment, different variables and their priorities.

In this paper for selecting the best contractor, numerous criteria were collected by asking from adept experts and then among them, 16 criteria with highest frequency was considered for questionnaire. These questionnaire was distributed between experts. Cronbach's alpha coefficient was obtained as 72%. Then based on Borda,s function 12 important criteria was selected which was categorized in four main criteria and related sub-criteria as follow: Environmental factors and physical equipment: proqurement and materials (supplier), company's machines, contractor's proposed cost estimate - financial capacity: bank turnover and company's assets, the income of tax declaration in last year, Ability to compensate for losses or delays - past performance- records and technical expertise: experts and key personnel, the past technical backgrounds and experiences, employer satisfaction of previous contracts, the number of similar projects was done - standards: rank and field of expertise which company is qualified for and its validity, availability and number of permitted projects done. Then with PROMTHEE method, the criteria was normalized and monitored, finally the best alternative was selected. In this research, qualitative criterias of each company is became a quantitative criterias. Finally information of some companies was evaluated and the best contractor was selected based on all criterias and their priorities.

Key Words: Contractor evaluation and selection, project development, supply chain management, , PROMTHEE method.

STOCHASTIC DYNAMIC LOT-SIZING PROBLEM WITH TOTAL QUANTITY DISCOUNT

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Abstract

Dynamic lot sizing problem is one of the significant problems in industrial units and has been considered by many researchers. Considering the quantity discount in purchasing cost is one of the important and practical aspects of inventory problems in the field of inventory control and management, and it has been less focused in terms of stochastic version of dynamic lot-sizing problem in inventory management. In this paper, the stochastic dynamic lot-sizing problem with the assumption of existence of all-units quantity discount in purchasing is defined and formulated. Two approaches are presented to handle the solving procedure of this problem. Since the considered model is a mixed integer non-linear programing model, and the objective function of the model is the only non-linear part of the model. At first, we introduce a piecewise linear approximation model to convert the objective function to a linear term. The main solution approach breaks down the problem into four levels. At the first level, a branch and bound algorithm branches the problem on the periods with a predetermined discount level. In this case, the problem is converted to constrained version of the Sox problem [10]. This sub problem raised in each node in the branch and bound algorithm, is a mixed integer non-linear programing too, which is solved based on a dynamic programming approach in the second level. In each stage, in this dynamic programming algorithm, there is a sub -problem which is solved via a branch and bound algorithm. The problem raised in each node of the recent branch and bound algorithm is solved with lagrangian relaxation method. The numeric results found in this study indicate that the proposed approach solves the problem faster than the mathematical programming model using the commercial software GAMS. Moreover, the proposed algorithm for the two discount levels is also compared with the approximate solution in the mentioned software. The results indicate that our algorithm up to 14 periods can not only obtain the exact solution, but also consume less time in contrast to the approximate model.

Key Words: Dynamic lot sizing problem, total quantity discount, branch and bound algorithm, dynamic programming, lagrangian relaxation method.

A GAME-THEORETIC APPROACH FOR COORDINATION OF PRICING

function that eventually led to integer linear model. We use centralized game approach to finding the optimal price of different levels. In the centralized channel, decision makers set the retail price that maximizes the total channel profit. Coordination of three parts of supply chain and centralized decision-making can improve the system-wide profit. A new method is developed to solve the problem. After that, different sensitive analyses are illustrated for profit function graph. The results show that in the lower level of vehicle capacity, much less profit exists, and in lower fixed cost of vehicle, even less than before.
After that, different sensitive analysis is illustrated for profit function graph.

Key Words: Supply chain, carrier-retailer channel, pricing, game theory.

SCHEDULING OF PREVENTIVE MAINTENANCE FOR PARALLEL, SERIES, AND SINGLE-ITEM REPLACEMENT SYSTEMS BASED ON STATISTICAL ANALYSIS

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Abstract

Preventive maintenance scheduling of generating units is addressed as a crucial issue in power system studies due to its severe impacts on power systems' asset management by reducing operation cost while enhancing reliability worth. In this paper, we describe an application of statistical analysis for determining the best preventive maintenance strategy in the case of parallel, series, and single-item replacement systems. A key aspect of industrial maintenance is the trade-off between cost and time of performing preventive maintenance operations. This article deals with two main issues related to the preventive maintenance in order to minimize the cost per unit time: (1) specifying the best time for performing preventive maintenance actions in parallel, series, and single-item replacement systems; (2) determining the required number of spare parts and facilities.
in single-item replacement and parallel systems, respectively. In this proposed maintenance strategy, preventive maintenance operations are regularly performed on the production unit in equal time intervals and maintenance actions return the facilities to a good-as-new condition. In the proposed model, the number of failures for a specified facility follows the Poisson distribution, and failure rate of the Poisson distribution follows Gamma process. In addition, equipment' failure being earlier than the determined starting time for the preventive maintenance operations would impose too much cost on each system. Therefore, to consider this constraint, it is assumed that there is a linear relation between recovering cost from unplanned failures and time to failure. Moreover, all costs related to maintenance are supposed to be known and the cost of a preventive repair is appreciably less than that of a failure and its associated repair. Finally, three examples are presented to demonstrate the effectiveness of the proposed models for each system. We use MATLAB software to obtain the optimal value of parameters in cost models in the proposed approach. To find the optimal value of decision variables in each system, a search procedure is applied.

Key Words: Preventive maintenance, parallel, series and single-item replacement systems, cost, statistical analysis.

SUPPLY CHAIN MANAGEMENT AND UTILIZATION OF PROMTHEE

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Abstract

There are many problems in contracting projects and their performance. At each project stage and due to different reasons, these problems affect cost, time and overall project quality. Hence, in order to increase the

Abstracts of Papers in English

PRICING DECISION IN CENTRALIZED CARRIER-RETAILER CHANNEL WITH GAME THEORY APPROACH

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Abstract

Pricing decision is one of the most important factors in the supply chain management. If demand is sensitive to the price, pricing decision becomes more important. In this case, with a slight change in the price of products or services, the customer changes his demand that impact on chain profit. In this study, a supply chain consists of two exclusive transport companies and a retail company is also taken into consideration. Each member of the system will affect price and then the profit of chain. Transport companies have a unique feature that makes them exclusive. Companies that transport hazardous chemical material, cargo liner companies in Iran and very large cargo transport company can be examples of this situation in the problem. The transport company can be a trucking company, a third-party logistics provider, or a freight forwarder. The retailer sets the retail price; this specifies the demand, which in turn, is the carrying amount for the transporters. Transporters decide the freight rate and their profit depend on both the freight rate and the carrying amount. Finally, the transporter's freight rate is an input of the retailer's cost that influences the retail price eventually. In this study, the transportation cost is divided into two categories: costs per unit of goods such as load, unload, and handling; the fixed cost per vehicle. The fixed cost includes the driver's salary, fuel charges, etc. We entered the cost per truck separately in transporters profit